HERMES III Waste Minimization Practices/Waste Minimization at Sandia National Laboratories/New Mexico (FY06)

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Abstract:

The **H**igh-**E**nergy **R**adiation **M**egavolt **E**lectron **S**ource or HERMES III Accelerator has been in operation for 18 years. Personnel at the HERMES III Accelerator have continually made strides to minimize waste throughout the years, but they have now taken waste minimization to the next level. Within the last year, they have developed and implemented procedures and measures to minimize waste by minimizing the use of hazardous chemicals, extending the life of the de-ionized (DI) resin beds, reusing and modifying test hardware, and reducing the needs of Sulfur Hexafluoride process gas. These comprehensive waste minimization techniques also have saved tens-of-thousands of dollars.

Overview:

In 1988 the **H**igh-**E**nergy **R**adiation **M**egavolt **E**lectron **S**ource or HERMES III Accelerator began testing. The HERMES III Accelerator is a modular, high power, large area, gamma ray simulation source. The HERMES III Accelerator has both an indoor and outdoor test cell where various articles, ranging from electronic circuits to military vehicles, can receive photon bursts to simulate the effects of prompt radiation.

The HERMES III Accelerator is a very large piece of equipment that measures 74 ft. wide, 48 ft. long, and 16ft. high. The pulsed power is divided into an oil insulated energy storage/compression section located in two open air tanks with water insulated pulse transmission lines and 20 cavities (on the centerline) located between them.

The accelerator requires periodic maintenance to ensure optimal performance. These activities can create large amounts of hazardous and solid waste. For the past 18 years, procedures have been optimized to conserve and minimize waste. Two examples of these waste minimization activities are as follows:

Used Dielectric Oil Reuse and Recycling Program:

100,000 Gallons of dielectric oil per week is re-circulated through storage tanks, the accelerator, through a filter system, and then returned back to the storage tanks. Prior to optimizing the oil recirculation process, the contaminated oil and filters produced during periodic maintenance would have been disposed of as hazardous waste. All of the contaminated oil is reused or recycled.

Copper Sulfate Recovery:

Copper sulfate is used as a resistive solution in high-current electrical resistors. Over repeated use, the copper sulfate becomes contaminated with a thick coagulated floc, which affects the resistivity of the solution. In the past, the contaminated solution was disposed of as hazardous waste and replaced by new copper sulfate. A two-stage filter using paper coffee filters was built to remove the thick floc. The copper sulfate that passively drips through the filters is clean enough for reuse. This accounts for 10-20 gallons per year in waste reduction.

Narrative:

The processes mentioned above have continued to work well over the last 15 years, but then personnel researched and made additional improvements in waste minimization at HERMES III. Within the last year, the HERMES III Program has realized the results of taking waste minimization to the next level by incorporating the following processes:

- Sulfur Hexafluoride (SF6) Optimization
- Elimination of Hazardous Chemicals for Parts and Equipment Cleaning
- DI Water Resin Bed - Extended Use
- Hardware reuse

Sulfur Hexafluoride (SF6) Optimization:

SF6 is used to hold off sparking when energy is switched from one component to another in an acrylic container. Over a period of a couple years, they have gradually reduced the amount and volume of purges of SF6 required. Originally, purges of SF6 were 600 pounds of gas per week. They have optimized the process to minimize this purging activity to 100 pounds per week on average, a savings of over 80%. This activity has also saved approximately $5000 per week in gas purchases.

Elimination of Hazardous Chemicals for Parts and Equipment Cleaning:

They have also made a concerted effort to update procedures to not use hazardous chemicals when cleaning parts and equipment during maintenance and testing procedures. Two years ago all of the parts and equipment was wiped down with isopropyl alcohol (IPA). At this time, IPA use only exists in the vacuum section of the facility. All other areas use non-toxic and non-hazardous cleaning chemicals such as Simple Green and soap and water. This has reduced the use of IPA by over 60% at the HERMES III facility. In the areas where IPA is used, the wipes and cloth are used until they are completely dry. This allows for the wipes and cloth to be thrown in the solid waste rather than the hazardous waste stream.

DI Water Resin Bed - Extended Use:

De-ionized (DI) Water flow rate is one of the main factors on the success of their process. When the flow rate goes below 1 gallon per hour, the procedure requires that the 4 resin bed cylinders that run 6400 gallons are replaced. During a maintenance check, they noticed that the reason for the low flow rates was due to the clogging of internal strainers. They realized that by setting up a periodic maintenance on the system and cleaning the strainers would allow for an extended life of the system. Prior to this change, the cylinders required replacement every quarter. The current procedure allows for a minimum of 1 year use. They believe the cylinders could last for two years or more.

Hardware Modifications and Reuse:

Aluminum cylinders are used as a vacuum vessel that contains the electron beam which generates radiation photons. These cylinders are large and expensive. They tested four new configurations to extend HERMES capabilities by using existing cylinders with in-house modifications or much less expensive adapter plates. The cost savings are in hardware (5 each at ~$10,000) and design/procurement time which effectively utilizes the accelerator. Not only have these modifications saved money but the adapter plates can continually be reused so that they are never wasted.

Likewise, the vacuum system is key to operation and is maintained with <$10,000 of hardware for pumps and gauges. This is the replacement cost for a single pump and the system is comprised of 13 pumps and a spare. Their in–house maintenance procedures allows for no downtime of the vacuum system with estimated cost savings of ~$25,000 in hardware while

effective use of accelerator ($50,000 per week recovery) could be >$50,000 during a year. In-house maintenance has extended the life of a pump from 3 months to a year or more thus reducing their waste by the same amount.

Conclusion:

The efforts taken by the personnel at the HERMES III Accelerator are exemplary. They have used waste minimization as a key to optimizing a process. Instead of purchasing new equipment in an effort to enhance the process, he worked with what he had and increased the overall efficiency of the process by doing so. This is an excellent example of what many process owners disregard – the ability to dissect every process step to continually enhance a process. These efforts have increased efficiency, reduced waste, and have driven costs down significantly. The personnel recently received an EMS Quarterly Environmental Excellence Award for their waste minimization practices and their work has been publicized on internal websites and newsletters.